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ABSTRACT

The planning and management of educational systems has been examined widely in the last decades despite the lack of a standard research method and a unified underlying theory. Research based on quantitative analysis yields data that may be processed using the graphic capabilities of computers. The combination of numerical data and computer graphics results in a visual, realistic presentation of scientific results. New computer software must be developed that will facilitate information analysis and visual presentation. Interactive video is an example of a video-computer technology that provides quick access to visual information, computer organization and control over database information, and use of that information. Qualitative information may be represented quantitatively by using a functional statistical model made up of factor and graph models. The information is then in a form that is easily assimilated by educational administrators, teachers, as well as other scientists. (DB)

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PRINCIPLES AND APPROACHES TO THE USE OF VIDEO-COMPUTER TECHNOLOGIES IN THE PLANNING AND MANAGEMENT OF EDUCATION

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1. INTRODUCTION

PLANNING AND MANAGEMENT OF EDUCATION HAS BEEN WIDELY EXPLORED IN THE LAST DECADES, BUT REAL SCIENTIFIC AND TECHNICAL DEVELOPMENT WAS POSSIBLE ONLY AFTER THE LARGE SCALE UTILIZATION OF COMPUTERS, INCLUDING IN THE DEVELOPING COUNTRIES.

THE EDUCATIONAL SYSTEM IS A COMPLEX STOCHASTIC SYSTEM, NOT COMPLETELY WORKED OUT. IT IS STRUCTURED IN 2, 3 OR MORE HIERARCHICAL ADMINISTRATION LEVELS, THE PRIMARY AND THE SECONDARY EDUCATION ON THE ONE HAND, AND THE HIGHER EDUCATION ON THE OTHER, BEING TWO PARALLEL STRUCTURES. IN MOST CASES THE FIRST LEVEL, THE SCHOOL OR THE UNIVERSITY, CAN BE PRIVATELY OR PUBLICLY FUNDED. IT ENSURES THE ACCUMULATION OF KNOWLEDGE, ABILITIES AND SKILLS, THE NECESSARY EDUCATION AND THE CONTROL OF THE EDUCATIONAL PROCESS.

THE SECOND LEVEL (THE MINISTRY) HAS SOLELY PLANNING AND ADMINISTRATIVE FUNCTIONS AND ARRANGES THE RELATIONS BETWEEN THE FIRST LEVEL AND THE STATE.

A SECOND AND EVEN A THIRD LEVEL CAN EXIST IN SOME BIGGER OR MULTINATIONAL COUNTRIES. FOR EXAMPLE, MINISTRIES, ORGANIZED ON THE BASIS OF A NATIONAL OR GEOGRAPHICAL FEATURE AND A STATE MINISTRY. THE MODEL OF SUCH A THREE LEVEL STRUCTURE CAN PARTIALLY BE BORROWED BY UNESCO FOR THE EXECUTION OF ITS SUPERVISORY AND CONSULTING FUNCTIONS.

IN FACT, THE ORGANIZATIONAL DIFFERENCES BETWEEN THE SECOND AND THE THIRD HIERARCHICAL LEVELS ARE COMPARATIVELY SMALL AND ARE DUE TO THE INTEGRATION LEVEL OF THE DATA AND THE NUMBER OF SUPERVIZED AND CONTROLLED OBJECTS. IF WE ELIMINATE SOME SPECIFIC CHARACTERISTICS, THEN WE SHALL SEE THAT THE ORGANIZATION AND THE ADMINISTRATIVE STRUCTURE OF A MINISTRY OF EDUCATION AND OF ANY OTHER MINISTRY, HAVE NO PRINCIPAL DIFFERENCES.

THESE SPECIFIC CHARACTERISTICS ARE OBSTRUCTIVE TO THE PLANNING AND MANAGEMENT OF EDUCATION, BECAUSE:

- IT IS PRACTICALLY IMPOSSIBLE TO EVALUATE THE CHARACTERISTICS OF THE DEVELOPMENT OF THE TRAINING AND EDUCATIONAL PROCESS SINCE MOST OF THEM ARE QUALITATIVE IN NATURE;
- THE PROCESS ITSELF IS NOT VERY WELL INVESTIGATED;
- THERE IS NO GENERAL PEDAGOGICAL THEORY, ETC.

THE BASIS FOR PLANNING AND MANAGEMENT OF EDUCATION MUST BE THE THOROUGH EXPERIMENTS AND APPLICATION OF MODERN NUMERICAL METHODS, COMPUTER AND VIDEOCOMPUTER TECHNOLOGIES. THE LATTER ARE NECESSARY AT ALL HIERARCHICAL LEVELS BECAUSE A GREAT BODY OF INFORMATION HAS TO BE PROCESSED, USED FOR TAKING DECISIONS AND LATER ON AS A BASIS FOR PLANNING AND FORECASTING

EDUCATIONAL DEVELOPMENT.

2. MANAGEMENT OF THE PROCESS OF TRAINING AND EDUCATION

THE PECULIARITIES OF THE EDUCATIONAL PROCESSES ARE CONCENTRATED AT THE LOWEST HIERARCHICAL LEVEL. THIS IS THE LEVEL ENSURING THE TRAINING PROCESS AND THE REPRODUCTION OF THE INTELLECTUAL VALUES.

A. ACQUISITION OF NEW KNOWLEDGE

ONE OF THE MAIN FACTORS CHARACTERIZING THE ACQUISITION OF KNOWLEDGE, ABILITIES AND SKILLS IS THE WAY OF PRESENTING NEW KNOWLEDGE BOTH IN INDIVIDUAL EDUCATION AND IN ORGANIZED EDUCATION - NEW LESSONS AT SCHOOL AND LECTURES AT UNIVERSITY.

ALL OF US REMEMBER OUR SCHOOL AND ACADEMIC YEARS, THE UNFORGETTABLE IMPRESSIONS OF THE LABORATORY EXPERIMENTS, THE INTERESTING FILMS, THE ROTATION OF THE GYROSCOPE, WHOSE AXIS IS FIXED ONLY ON ONE SIDE, THE CHEMICAL EXPERIMENTS AND ESPECIALLY THOSE WITH FLASH AND THUNDER.

TEACHERS AND SCIENTISTS UNDERSTOOD LONG AGO THE SIGNIFICANCE OF THE VISUALIZATION OF SCIENTIFIC INFORMATION WHILE LEARNING NEW MATERIAL.

THE TASK OF THE SCIENTIST IS NOT ONLY TO ACHIEVE NEW SCIENTIFIC RESULTS, BUT ALSO TO PRESENT THEM CLEARLY AND SIMPLY, SO THAT IT MIGHT BE EASIER FOR HIM AND HIS COLLEAGUES TO ACQUIRE NEW KNOWLEDGE.

IN SOME CASES, SCIENTISTS FROM DIFFERENT SCHOOLS OBTAIN THE SAME RESULTS USING DIFFERENT SCIENTIFIC APPROACHES, METHODS AND ACTUAL APPARATUS, WHICH SOMETIMES LEADS TO MISUNDERSTANDING.

VISUAL IMAGES HELP SCIENTISTS AND LECTURERS TO EXPLAIN THEIR IDEAS AND THEORIES MUCH MORE COMPREHENSIVELY. PERHAPS THEY ARE ONE OF THE MOST SUCCESSFUL WAYS OF PRESENTING THE THOUGHTS AND STATEMENTS IN SCIENTIFIC RESEARCHES.

FOR 20 YEARS NOW COMPUTERS HAVE BEEN USED IN SCIENTIFIC RESEARCHES AND FOR THE LAST 5 - 6 YEARS IN EDUCATION. AT THE BEGINNING THEIR GRAPHIC RESOURCES WERE VERY EXPENSIVE AND WERE PROBABLY JUST A DOUBTFUL DECORATION. SOME SPECIALIZED COMPUTERS COULD DRAW LINES ON THE SCREEN. THE GRAPHIC CAPABILITIES CONSISTED IN ORDERING SYMBOLS ON THE SCREEN IN LINES, COLUMNS OR SOME OTHER COMBINATIONS. WITH SOME DIFFICULTY, SIMPLE DESIGNS OR COMBINATIONS OF SYMBOLS COULD BE REPRODUCED.

WITH THE APPEARANCE OF PERSONAL COMPUTERS, THE GRAPHIC CAPABILITIES FOR ANIMATION BECAME WIDELY USED. STEP BY STEP THE NUMBER OF THE COLOURS USED AND THE RESOLUTION CAPABILITY OF THE VIDEOMEMORY AND THE MONITOR WERE INCREASED. ALL THAT ENABLED SCIENTISTS AND ESPECIALLY LECTURERS TO SOLVE PROBLEMS OF MEDIUM DIFFICULTY SUCH AS PROCESSING A GREAT DATA BASE, FOR A TIME SATISFACTORY FOR THEIR RESEARCHES AND TRAINING PROCESS. THE RESULTS OF THESE RESEARCHES OR CALCULATIONS CAN ALREADY BE VISUALLY PRESENTED. IN ADVERTIZING, BUSINESS, EDUCATION, ETC., GRAPHIC SYSTEMS BECAME WIDELY SPREAD. THEY COULD DRAW IN COLOURS AND ANIMATE SIMPLE TWO - DIMENSIONAL OBJECTS, THE CONNECTIONS AND RELATIONS BETWEEN THEM. IN MOST CASES, COMPUTERS DREW FIGURES AND PRINTED TEXTS, WHICH WERE CONTAINED IN

THE TEXTBOOKS AND COULD BE SHOWN BY SLIDES, POSTERS AND OTHER SIMILAR MEANS. THE "NEW" APPROACH AND THE QUICK ACCESS AND STORAGE OF VISUAL INFORMATION WHICH COULD BE PERFORMED BY EVERY SCIENTIST OR TEACHER WAS VERY ENTICING.

THOUGH NOT VERY OFTEN, TWO-DIMENSIONAL VISUALIZATION AS A RESULT OF CALCULATIONS, MATHEMATICAL MODELLING, STATISTICS OR BUSINESS GRAPHICS, GRAPHIC RESULTS OF CAD SYSTEM DESIGN ARE USED. THE CREATION OF SUCH VISUALIZATIONS IS POSSIBLE ONLY WITH THE HELP OF COMPUTERS. IT GIVES SCIENTIFIC AND PRACTICAL JUSTIFICATION FOR THEIR APPLICATION IN THE REPORTS ON SCIENTIFIC RESEARCHES AND IN THE PRESENTATION OF KNOWLEDGE IN THE TRAINING PROCESS.

DURING THE PAST YEARS THE DEVELOPMENT OF MODERN TECHNOLOGIES PRACTICALLY OVERLOADED SCIENTISTS WITH A VARIETY OF DATA. FOR EXAMPLE, GEOLOGICAL, PHYSICAL, CHEMICAL AND OTHER RESEARCHES INCLUDE AND REQUIRE PROCESSING OF GREAT QUANTITIES OF DATA. SPACE PROBES, SATELLITES REVOLVING AROUND THE EARTH SEND CONTINUOUS DATA FOR ASTRONOMY, ASTROPHYSICS, GEOPHYSICS, METEOROLOGY, ETC. MOST OF THESE DATA ARE STORED ON TAPES AND ARE SENT TO STATE STORES BECAUSE THERE ARE NO METHODS OR EQUIPMENT FOR THEIR PROCESSING. THE SAME ARE THE PROBLEMS IN MEDICINE (DIAGNOSTICS AND TREATMENT), IN SOCIOLOGY (DEMOGRAPHY, EDUCATIONAL REFORMS), ETC. FOR EXAMPLE, IN THE FIELD OF MOLECULAR MODELLING, SCIENTISTS AND RESEARCHERS USE STYROFOAM AND WIRE MODELS, THEY DRAW DIAGRAMS AND PRESENT THE STRUCTURE OF MOLECULES. BUT THAT IS NOT ENOUGH BECAUSE THE SPACE IN WHICH THE MOLECULES ARE STRUCTURED IS NOT COMPACT, NEITHER IS IT FILLED WITH QUICKLY MOVING ELECTRON CLOUDS. THE STRUCTURE OF THE MOLECULES IS NOT STATIC, THEIR SPACE GEOMETRY IS DEPENDENT ON THE ENERGY CHANGES, ON THE INTRAMOLECULAR FORCES AND ON

OTHER FACTORS. THE SAME IS TRUE OF DEMOGRAPHIC POPULATIONS, OF PLANNING AND FORECASTING OF EDUCATION.

THESE PROBLEMS CAN BE SOLVED BY APPLYING VISUALIZATION METHODS TO SCIENTIFIC RESULTS. IN THIS WAY, THE POTENTIALITIES OF THE METHODS AND TECHNOLOGIES OF THE WELL-KNOWN APPROACHES OF COMPUTER GRAPHICS AND ANIMATION ARE INCREASED. THIS VISUALIZATION INTEGRATES FIELDS OF STUDY WHICH HAVE BEEN INDEPENDENT SO FAR, SUCH AS COMPUTER GRAPHICS, COMPUTER VISION, IMAGE PROCESSING, AUTOMATED DESIGN, SIGNAL PROCESSING, MATHEMATICAL MODELLING, MAKING DECISIONS, ARTIFICIAL INTELLIGENCE, ETC.

SO FAR AS THE VISUALIZATION OF SCIENTIFIC RESEARCHES AND THE LEARNING PROCESS ARE RELEVANT TO THE USE OF VISUAL IMAGES FOR INTERPRETATION OF SCIENTIFIC DATA AND IMAGES, THE PROVISION OF METHODS AND MEANS FOR INFLUENCING THESE VISUAL IMAGES IN REAL TIME IS OF GREAT SIGNIFICANCE.

THESE ARE SOME OF THE ADVANTAGES OF VISUALIZATION: IMPROVEMENT OF THE QUALITY OF THE ANALYSES, POSSIBILITY FOR REACTION AND CONTROL OVER THE EXPERIMENT IN REAL TIME, REDUCING THE EXPENSES, ETC.

OF GREAT IMPORTANCE IS THE POSSIBILITY FOR QUICK EVALUATION OF A SCIENTIFIC INVESTIGATION AS AN IMPORTANT SCIENTIFIC RESULT. FOR EXAMPLE, THE COMBINING OF THE METHODS AND TECHNOLOGY OF COMPUTER GRAPHICS AND IMAGE PROCESSING MAKES THE VISUAL COMPARISON BETWEEN THEORY AND EXPERIMENTAL RESULTS AND OBSERVATIONS POSSIBLE. IF THE IMAGE OBTAINED AFTER ANALYSIS OF THE RESULTS IS SUPERIMPOSED ON THE SCREEN ON THE PHYSICAL MODEL (GEOMETRICAL FIGURE) I.E. THEORETICAL MODEL, NOT ONLY VISUAL COMPARISON BUT ALSO COMPARISON USING IMAGE PROCESSING METHODS CAN BE USED.

THE OPTIMIZATION OF THE THEORETICAL MODEL OR THE EXPERIMENT CONTROL IS CARRIED OUT BY USING THE MAIN FACTORS AND DATA CREATING THE MODEL OR THE PARAMETERS CONTROLLING THE PROCESS OR THE PHENOMENON.

SUCH A VISUALIZATION IS ACCESSIBLE TO A DEFINITE NUMBER OF RESEARCH TEAMS USING SUPERCOMPUTERS. IT IS NECESSARY THAT THE VISUALIZATION METHODS SHOULD BE USED BY THE MAJORITY OF SCIENTISTS. OBVIOUSLY, IN THE NEAR FUTURE, THE SUPERCOMPUTERS WOULD NOT BE WIDELY USED BECAUSE OF THEIR HIGH PRICE.

NOWADAYS, MOST OF THE SCIENTIFIC AND EDUCATIONAL INSTITUTES OF THE DEVELOPING COUNTRIES POSSESS QUITE A NUMBER OF PERSONAL COMPUTERS ENSURING AN IMPRESSIVE COMPUTATIONAL CAPACITY. HOWEVER, THAT CAPACITY DOES NOT SATISFY THE REQUIREMENTS FOR PEAK CAPACITY WHICH IS NECESSARY FOR A GREAT NUMBER OF CALCULATIONS FOR CREATING VOLUME VISUALIZATION IN REAL TIME. FOR EXAMPLE, IF A MAN CAN DIG A WALL FOR 100 DAYS, 100 MEN CANNOT DIG THE WALL FOR ONE DAY.

ONE OF THE WAYS OF ACCESS TO SUPERCOMPUTERS IS THE USE OF HIGH QUALITY GRAPHIC STATIONS WITH IN-BUILT HARDWARE GRAPHIC POSSIBILITIES CONNECTED TO THE SUPERCOMPUTERS THROUGH LOCAL NETWORKS.

THAT METHOD EXCLUDES THE DATA VISUALIZATION IN REAL TIME BECAUSE OF THE LIMITED COMPUTATIONAL CAPACITY AND THE VOLUME OF MEMORY IN WORKSTATIONS. ANOTHER PROBLEM IS THE LOW SPEED OF DATA MOTION IN THE NETWORK. IN THAT CONNECTION, IN ORDER TO REDUCE DATA VOLUME, THE SUPERCOMPUTER HAS TO PERFORM PART OF THE CALCULATIONS ITSELF. MAYBE A SOLUTION TO THAT PROBLEM WOULD BE THE SPECIAL "GRAPHIC" NETWORKS WHICH WILL MAKE VISUALIZATION POPULAR FOR MORE SCIENTISTS, TEACHERS, ENGINEERS, ETC.

IN OTHER CASES, THE REALIZATION OF VOLUME VISUALIZATION "OFF LINE" IS USED. SUPERCOMPUTERS CREATE THE RELEVANT VOLUME IMAGE RECORDED ON A VIDEOCARRIER (LASERDISC OR VIDEOTAPE) AND AFTER THAT IT IS SUBMITTED FOR DISCUSSION OR VISUALIZATION OF THE PROCESS.

THAT METHOD HAS ITS ADVANTAGES. A DISADVANTAGE IS THE ABSENCE OF CONTROL AND MANAGEMENT IN REAL TIME CONCERNING QUICK PROCESSES AND PHENOMENA. THAT IS SO BECAUSE THE IMAGE IS RECORDED AND IT IS IMPOSSIBLE TO REACT QUICKLY. BUT THAT DOES NOT CONCERN SLOW PROCESSES AND PHENOMENA WHERE TIME IS NOT A LIMITATION. IN SOME CASES THIS DISADVANTAGE CAN TURN INTO AN ADVANTAGE. THE DATA VISUALIZATION OF SLOWLY RUNNING PROCESSES MAY CONTINUE TOO LONG AND BOTH THE SCIENTISTS AND THE AUDIENCE WOULD NOT HAVE THE TIME TO WAIT LONG ENOUGH. THERE ARE TWO ALTERNATIVES. THE FIRST IS: DATA ARE COLLECTED IN THE PROCESS OF VISUALIZATION IN REAL TIME BY A SUPERCOMPUTER WHICH IS NOT ALWAYS AVAILABLE. THEREFORE, IN SOME CASES, THE MOMENT FOR AN ACTIVE INTERFERENCE AND CONTROL OF THE PROCESS MIGHT BE MISSED.

THE SECOND POSSIBILITY IS THE USE OF SMALLER COMPUTATIONAL CAPACITIES AND DISTRIBUTED PROCESSING WHICH IS MUCH MORE SUITED TO THE NEEDS OF VARIED RESEARCH TEAMS.

THE IMAGES CREATED AT DEFINITE INTERVALS OF TIME ARE VIDEORECORDED. AFTER THAT THEY ARE PLAYED AT A SUITABLE SPEED AND THUS THE DYNAMICS AND THE CHARACTERISTICS OF THE PHENOMENA OBSERVED COULD BE CAUGHT.

THAT APPROACH IS EXTREMELY SUITABLE FOR EDUCATION BECAUSE MOST OF THE OBSERVED, CONTROLLED AND PLANNED PROCESSES DEVELOP COMPARATIVELY SLOWLY AND THE FINANCING OF SCIENTIFIC AND EDUCATIONAL INSTITUTES IS LIMITED AND BASED ON SUBSIDIES,

SPONSORS, ETC. ONE OF THE ADVANTAGES OF THE METHOD IS THAT THE IMAGES COULD BE REPRODUCED MANY TIMES WITHOUT THE LOSS OF THE EXPENSIVE MACHINE TIME OF SUPERCOMPUTERS OR OTHER POWERFUL COMPUTERS.

THE COMBINATION OF VIDEO AND COMPUTER TECHNOLOGIES CREATES AN INCREASED EFFECT ON THE VISUALIZATION OF SCIENTIFIC RESEARCHES AND THE EDUCATIONAL PROCESS. AS A RESULT OF THAT COMBINATION, SCIENTIFIC AND EDUCATIONAL FILMS WITH COMPUTER GRAPHICS AND ANIMATION ARE CREATED.

THE PROCESS DEVELOPMENT AND THE PHENOMENA IN THEIR REAL ENVIRONMENT AND CONDITIONS ARE RECORDED AND AFTER THAT DEMONSTRATED BY A CAMERA,WHILE COMPUTER GRAPHICS AND ANIMATION REPRESENT THE THEORETICAL MODELS, SCIENTIFIC RESULTS OF DATA PROCESSING, ETC. HERE COMPUTER GRAPHICS AND ANIMATION HAVE TWO POSSIBLE REALIZATIONS:

- CREATION OF TWO-DIMENSIONAL AND THREE-DIMENSIONAL GRAPHIC IMAGES, TEXT, FORMULAE, TITLES AND GRAPHICS MADE IN A DIFFERENT WAY AND AFTER THAT FILMED BY A CAMERA OR SUPER-IMPOSED ON THE CARRIER. IN THAT CASE COMPUTER GRAPHICS AND ANIMATION ARE EASILY PRODUCED BY GRAPHIC EDITORS, AUTHORING ANIMATION SYSTEMS, CAD SYSTEMS, ETC. WHICH ARE AVAILABLE FOR EVERY SCIENTIST OR TEACHER; "CAMERA-LESS" ELECTRONIC RECORDING AND IMAGE MIXING IN VIDEOFILM MONTAGE, ETC.

- CREATION OF VOLUME VISUALIZATION OF THE SCIENTIFIC RESULTS AND THE PROCESSING OF EXPERIMENTAL DATA. THIS VISUALI-ZATION CAN BE PRODUCED ONLY WITH THE HELP OF COMPUTERS WITH GREAT GRAPHIC POSSIBILITIES. THE WIDE ACCESS OF SCIENTISTS, LECTURERS AND SPECIALISTS TO SUCH TECHNOLOGY FOR CREATION OF SCIENTIFIC, EDUCATIONAL AND POPULAR SCIENCE FILMS USING COMPUTER GRAPHICS AND ANIMATION, REQUIRES READILY AVAILABLE HARDWARE AND SOFTWARE. MOST OF THE SCIENTIFIC AND EDUCATIONAL

PROBLEMS COULD BE ANALYSED WITHOUT THE USE OF HIGHLY QUALIFIED VOLUME GRAPHICS AND SUPERCOMPUTERS. "ASTOUNDING" VISUALIZATION IS NOT ALWAYS NECESSARY FOR OBTAINING SCIENTIFIC OR EDUCATIONAL VALUE. THE CREATION OF SCIENTIFIC AND EDUCATIONAL FILMS ENABLES A STEP-BY-STEP BUILDING UP OF DYNAMIC IMAGES WITH THE HELP OF LOW CAPACITY COMPUTERS AND GRAPHIC WORKSTATIONS BASED ON PERSONAL COMPUTERS WITH EXPANDED GRAPHIC POTENTIALITIES. ALONG WITH THAT, IT TS NECESSARY TO DEVELOP SOFTWARE FOR THE CREATION OF VOLUME VISUALIZATION IN ORDER TO ENSURE WIDE ACCESS:

- OF THE SCIENTIFIC AND TEACHING COMMUNITY;
- TO THOSE CHARACTERISTICS OF THE HARDWARE REQUIRED FOR VISUALIZATION IN ORDER TO OPTIMIZE ITS POTENTIALITIES AND TO ADAPT THEM TO THE FUTURE CHANGES IN HARDWARE TECHNOLOGIES;
- TO SOFTWARE USED AT THE MOMENT AS WELL AS ITS DEVELOPMENT.

IT MUST BE KEPT IN MIND THAT THE WIDE APPLICATION OF COMPUTER VISUALIZATION TECHNOLOGIES IN SCIENTIFIC, EDUCATIONAL AND SCIENCE POPULAR FILM PRODUCTION REQUIRES THE OVERCOMING OF CULTURAL DIFFERENCES AND DIFFERENCES IN THE TECHNICAL KNOWLEDGE AND SKILLS OF THE SCIENCES AND HUMANITIES COMPUTER USERS.

B. MANAGEMENT OF THE PROCESS OF ATTAINMENT OF KNOWLEDGE, ACQUISITION OF ABILITIES AND SKILLS

THE MANAGEMENT OF THAT PROCESS IS A VERY COMPLEX PROBLEM. MOST OF THE CHARASTERISTICS OF THE PROCESS COULD BE QUALITATIVELY DEFINED AND COULD HARDLY BE QUANTITATIVELY EVALUATED BECAUSE OF LACK OF ADEQUATE METHODS. NEVERTHELESS, THE FOLLOWING FUNCTIONAL STATISTICAL MODEL COULD BE USED AS THE BASIS FOR AN EXPERIMENT AND PROOF OF A SCIENTIFIC HYPOTHESIS. IT FOLLOWS FROM TWO OTHER MODELS: THE FIRST OF THEM IS A POPULAR FACTOR MODEL, THE OTHER IS A GRAPH MODEL WHICH REFLECTS THE DEVELOPMENT OF THE EDUCATIONAL PROCESS. THE AIM OF MODELLING IS TO DETERMINE THE TIME AND THE EVALUATION CHARACTERISTICS OF THE PARTICIPANTS IN EDUCATION, AS WELL AS THE CONDITIONS FOR ITS DEVELOPMENT.

THE FACTOR MODEL HAS TWO SUBSYSTEMS: MANAGING /MS/ AND MANAGEABLE / OBJECT OF MANAGEMENT - OM/

$MS \rightarrow OM$ THROUGH $\vec{Y}$

$OM \rightarrow MS$ THROUGH $\vec{X}$

$\vec{X}^{\circ} \rightarrow OM$ AND MS ; $\vec{Z} \rightarrow OM$,

WHERE:

$\vec{X} = (X1, \ldots, XN)$ - VECTOR OF COMBINATIONS OF DEFINITE CONTROLLABLE QUANTITIES AS VOLUME, SYSTEMATICITY, RATIONALIZATION, AUTOMATION OF KNOWLEDGE, PHYSIOLOGICAL AND PSYCHOLOGICAL PERSONALITY CHARACTERISTICS, LABOUR DISCIPLINE, SOCIAL DEMOGRAPHY CHARACTERISTICS AND SOME OTHERS AT AN I-MOMENT OF EDUCATION.

$\vec{X}^{\circ}$ = (X1,...,XN) - VECTOR OF COMBINATIONS OF KNOWN CONTROLLABLE OUTER INFLUENCES AND STATES AS VOLUME, SYSTEM, ETC. UNTIL THE BEGINNING OF EDUCATION

$\vec{Y}$ = (Y1,...,YN) -VECTOR OF COMBINATIONS OF CONTROLLING INFLUENCES AS SYSTEM, DIDACTIC MANAGING STRATEGIES DIFFERRING IN TIME, VOLUME, EXCESS OF INFORMATION, METHODOLOGY, ETC.

$\vec{Z}$ = (Z1,...,ZN) - VECTOR OF COMBINATIONS OF KNOWN AND UNKNOWN, BUT NON-MEASURABLE INFLUENCES. FOR EXAMPLE, GENETIC FEATURES OF AN INDIVIDUAL, MICROCLIMATE OF THE GROUP, FAMILY, ETC.

THE AIM OF THE MANAGEMENT OF THE EDUCATIONAL PROCESS WILL BE THE MAXIMIZATION OF $\overline{X(T)} = \max \overline{X}$, WHERE $\overline{X}$ E - MATHEMATICAL EXPECTATION OF THE ASSESSMENTS FOR ALL SUBJECTS. TO DEFINE THE ACCUMULATION OF KNOWLEDGE BY ONE OR A GROUP OF STUDENTS, THE TERM

$D = X(X^{\circ}, Y, Z) - X^{\circ}$, IS USED.

FOR THE ERRORS OF EDUCATIONAL CONTROL THE FOLLOWING EXPRESSION IS USED:

$\Delta XI = X\ OPT - X(TI)$,

WHERE:

X OPT - FUNCTION OF THE STUDENT CONDITION PROVIDED BY THE OPTIMAL CONTROL ALGORITHM.

X (TI) - FUNCTION OF THE STUDENT CONDITION AT THE TI-MOMENT OF EDUCATION PROVIDED BY THE CONTROL SYSTEM.

THE DEVELOPMENT OF THE EDUCATIONAL PROCESS IN TIME IS EXPRESSED BY THE GRAPH G (8, 11) , (FIG. 2).

NK → IT1 → (S.V.LP.V.P) → IT2 → NK.V.C → NK.V.FC (E),
WHOSE PEAKS ARE THE FORMS OF THE TRADITIONAL EDUCATIONAL SYSTEM:

NK - NEW KNOWLEDGE; IT1 AND IT2 - INDIVIDUAL TRAINING BEFORE AND AFTER PRACTICAL TRAINING; S - SEMINARS; L - LABORATORY PRACTICE; P - PROJECTS; C - CONTROL (PERMANENT); FC - FINAL CONTROL OR E - EXAMINATION.

REMEMBERING ULAAM'S HYPOTHESIS THAT THE SET OF SUBGRAPHS G GIVES COMPLETE INFORMATION ABOUT THE WHOLE GRAPH G, WE CAN DEFINE:

1. GRAPH RANGE - R(G) - LENGTH OF THE SHORTEST SIMPLE CYCLE WHOSE PEAKS ARE NK→IT1→(S.V.L.V.P)→IT2. THAT CYCLIC SUBGRAPH REPRESENTS THE LEARNING OF SPECIFIC THEMES OF THE SUBJECT AND CORRESPONDS TO THE PERIODICITY OF PERMANENT CONTROL.

2. GRAPH CYCLE - C(G) - LENGTH OF THE LONGEST SIMPLE GRAPH CYCLE WITH PEAKS: NK→IT1→(S.V.L.V.P)→IT2→C. THIS SUPERGRAPH REPRESENTS THE LEARNING OF A DEFINITE PART OF THE SUBJECT AND THE PERMANENT CONTROL.

3. GRAPH DIAMETER - D(G) - LENGTH OF THE LONGEST GEODESIC NK→IT1→(S.V.L.V.P)→IT2→C→FC.

THE MAIN GRAPH IS OBTAINED AFTER REMOVING THE CYCLES. THE OBJECTIVE PEAK SHOWS THE COMPLETION OF LEARNING THE SUBJECT AND CORRESPONDS TO THE FINAL CONTROL - THE EXAMINATION.

THE PROCESS DEVELOPS IN A SPIRAL WAY. GRAPH G, WHICH SHOWS THE SEQUENCE OF PHENOMENA, IS THE PROJECTION OF THAT

SPIRAL, EACH NEW TURN BEING FILLED WITH QUALITATIVELY NEW INFORMATION REPRESENTING A NEW STAGE OF KNOWLEDGE.

VIDEOCOMPUTER TECHNOLOGIES MAKE PRESENTATION AND OBTAINING NEW KNOWLEDGE (NK) EASIER. THE PROBLEM OF CONSOLIDATION OF KNOWLEDGE AND THE ACQUISITION OF ABILITIES AND SKILLS IS SOMEWHAT DIFFERENT AND IS CHARACTERIZED BY A PART OF THE GRAPH DIAMETER IT1 → (S.V.L.V.P) → IT2→C. THE CLOSER TO REAL CONDITIONS THE BETTER THE RESULTS OF PRACTICAL TRAINING. THIS IS ACHIEVED BY USING REAL-LIFE EQUIPMENT AND SYSTEMS. UNFORTUNATELY, THAT IS NOT POSSIBLE FOR MOST OF THE SUBJECTS. A COMPROMISE IS THE USE OF INTERACTIVE VIDEO (IV). IT HAS THE FOLLOWING ADVANTAGES:

- QUICK ACCESS TO VISUAL INFORMATION REVEALING THE REAL CONDITIONS OF PROCESS OR PHENOMENON DEVELOPMENT;

- FORMULATING THE PROBLEMS NOT ONLY FORMALLY OR VERBALLY BUT ALSO PLAYING VIDEOTAPED PROBLEM SITUATIONS;

- COMPUTER ORGANIZATION AND CONTROL OVER GREAT DATA BASE AND KNOWLEDGE BASE NECESSARY FOR THE DEVELOPMENT OF ABILITIES AND SKILLS; A POSSIBILITY OF GREATER DATA BASE FOR THE LEARNERS CHARACTERIZING THE LEARNING PROCESS OF INDIVIDUALS, WHOLE GROUPS OF TRAINEES , AS WELL AS TEACHERS' PROBLEMS;

- A POSSIBILITY OF CONTROLLING KNOWLEDGE CONSOLIDATION BY INDIVIDUALS AND GROUPS OF STUDENTS. THE DATA STORED ALLOW THE PREDICTION OF THE PROCESS DEVELOPMENT BY APPLYING STATISTICAL METHODS, EXPERIMENT PLANNING METHODS UNDER INDEFINITE CONDITIONS, ETC.

ADEQUATE SYSTEMS FOR QUANTITATIVE EVALUATION OF THE QUALITATIVE CHARACTERISTICS OF KNOWLEDGE ASSIMILATION ARE

WORTH STUDYING HERE. THE NECESSITY OF DEVELOPING GENERALIZED CRITERION EVALUATING MODELS AND UNIVERSAL TEST-PACKAGES IS OBVIOUS NOWADAYS. THEY WOULD BE AIMED AT OBTAINING A REAL PICTURE OF THE IMPLEMENTATION OF THE EDUCATIONAL REFORM IN A PARTICULAR COUNTRY. I WOULD LIKE TO MENTION HERE THAT SUCH RESEARCHES ARE CARRIED OUT AT THE NETHERLANDS INSTITUTE FOR MEASURING IN EDUCATION, THE HIGHER EDUCATION SCIENTIFIC RESEARCH INSTITUTE - MOSCOW, THE GERMAN INSTITUTE OF INTERNATIONAL EDUCATION, THE EDUCATIONAL VIDEOCOMPUTER CENTRE OF THE HIGHER INSTITUTE OF MECHANICAL AND ELECTRICAL ENGINEERING-SOFIA, ETC.

I FIND IT REASONABLE TO PROPOSE TO THE DEPARTMENT OF PLANNING AND MANAGENENT OF EDUCATION AND TO THE DEPARTMENT OF HIGHER TECHNICAL EDUCATION A PARALLEL PROJECT FOR DEVELOPMENT OF MODELS AND METHODS OF PLANNING AND MANAGEMENT APPLICATION IN HIGHER AND SECONDARY EDUCATION.

A MODEL OF THIS KIND WOULD LOOK LIKE THIS:

LET 'S EXAMINE THE PROCESS OF LEARNING OF SUBJECT MATTER Q WHICH HAS Ai CHAPTERS. IF A HELIX WHOSE PROJECTION IS GRAPH G, IS ARBITRARILY EXTENDED IN TIME, THEN THE CURRENT CHECKS Q OF THE PEAK K DETERMINE THE MASTERING OF CHAPTER Ai. A GENERAL SYSTEM OF N TEST-QUESTIONS IS DEVELOPED FOR THE QUANTITATIVE DETERMINATION OF ANY PARAMETER OF KNOWLEDGE ATTAINMENT (E.G. VOLUME). EACH PERSON TRAINED IS GIVEN A TEST WITH N QUESTIONS AND EACH ANSWER IS ASSESSED WITH THE NUMBER X HAVING K DEGREES OF PROFICIENCY. THE DISTRIBUTION OF THE DEGREES OF PROFICIENCY OF A SUBJECT IS DISCRETE. MATHEMATICAL EXPECTATIONS $\overline{X}$ AND $\overline{\overline{X}}$ OF THE ATTAINMENT OF ALL TEST QUESTIONS IN A CHAPTER COULD BE APPROXIMATED NORMALLY, NORMALLY CUT OR AS A GRAMME - SHARLE - EDGEVORT DISTRIBUTION.

THE MAIN CHARACTERISTICS I.E. THE MATHEMATICAL EXPECTATION, A ROOT MEAN SQUARE DEVIATION, THE ASYMMETRY AND EXCESS COEFFICIENTS, AS WELL AS SOME OTHERS COULD DETERMINE THE WAY OF ASSIMILATION ON PARAMETERS.

FOR EXAMPLE, THE BIGGER THE MODULE OF THE NEGATIVE ASYMMETRY COEFFICIIENT KA, THE BETTER THE MASTERING OF A PART OF THE SUBJECT, AND VICE VERSA, THE BIGGER THE MODULE OF THE POSITIVE MEANING OF KA, THE POORER THE MASTERING OF A PART OF A SUBJECT WITH RESPECT TO A CERTAIN PARAMETER.

THE DEPENDENCE OF THE MATHEMATICAL EXPECTATIONS X ON TIME CAN BE LINEARLY (FIG. 3) OR QUADRATICALLY APPROXIMATED.

$$\overline{\overline{X}} = KTI + B + \xi$$

OR

$$\overline{\overline{X}} = LT^2 I + KTI + B + \xi$$

WHERE, THE LEAST SQUARES METHOD, THE COEFFICIENTS WHICH MINIMIZE THE MEAN ROOT ERROR OF THESE APPROXIMATIONS CAN BE CALCULATED. USING THE STANADARD VARIABLE QUANTITIES

$$U = \frac{T - \overline{T}}{\sigma_T} \quad \text{AND} \quad V = \frac{X - \overline{\overline{X}}}{\sigma_X},$$

THE TWO DEPENDENCES MENTIONED ABOVE COULD BE EXPRESSED IN THE FOLLOWING WAY:

$$V = LU + A(U^2 - 1) + \xi,$$

WHERE $\gamma_1 = \overline{U^3}$ - ASYMMETRY,

$\gamma_2 = \overline{U^4} - 3$ - TIME DISTRIBUTION EXCESS OF THE CURRENT CHECKS AND

$Q = \overline{UV}$ AND $Q = \overline{U^2 V}$ - COEFFICIENTS OF CORRELATION BETWEEN THE KNOWLEDGE ATTAINMENT DEGREE AND THE TIME OF CURRENT CHECKS.

$A = \dfrac{\rho_{iTx} - \gamma_i \rho_{Tx}}{2 + \gamma_2 - \gamma_1^2}$ - COEFFICIENT OF PARABOLIC APPROXIMATION EQUAL TO 0 WHEN IT IS LINEAR

$L = \rho_{Tx} - \gamma_1 A$ - COEFFICIENT OF LINEARITY, WHERE THE STATISTIC ERROR ξ IS $\xi = 0$ AND $\overline{\xi} = 1 - \rho_{Tx}^2 - A(\gamma_1 \rho_{Tx} - \rho_{TT}$

THE IDEAL CASE OF CONTROL IS THE CASE WHEN THE GROUP MATHEMATICAL EXPECTATION OF THE MARKS REFERRING TO ANY ATTAINMENT PARAMETER OF CONTROL TESTS IN PART $\overline{\overline{X}}$ OF A SUBJECT IS MAXIMAL AND IT IS NOT DEPENDENT ON THE TIME OF CURRENT CONTROL, E.G. $L = K = 0$ AND $B = MAX$ OR IN STANDARD VARIABLE QUANTITIES A AND $L = 0$, AND $\overline{\overline{X}} = MAX$.

THE ABSOLUTE, RELATIVE AND REAL CONTROL ATTAINMENT ERROR AND THE ABSOLUTE, RELATIVE AND REAL ATTAINMENT CRITERIA, ARE RESPECTIVELY:

$$C_{IABS} = \frac{\overline{\overline{XI}}}{B_{MAX}} ; \quad C_{IREL} = \frac{\overline{\overline{XI}}}{B_{OPT}} ; \quad C_{IR} = \frac{\overline{\overline{XI}}}{\overline{\overline{X}}^{\circ}} ,$$

WHERE $\overline{\overline{X}}^{\circ}$ IS THE EXPERIMENTAL MATHEMATICAL EXPECTATION OF THE ATTAINMENT PARAMETER MARK OF THE WHOLE SUBJECT. IT IS NOT DIFFICULT TO PROVE THAT

$$\sum_{i=1}^{n} \Delta i x q = 0 \quad \text{or} \quad \frac{1}{n} \sum_{i=1}^{n} Ciq = 1$$

THE STORED STATISTICS ENABLE THE DEVELOPMENT OF THE SO CALLED EDUCATION HISTORY, LEADING TO BETTER ADAPTING THE CONTROL AND EDUCATIONAL SYSTEMS TO THE LEARNERS' NEEDS.

A METHOD FOR PREDICTING THE LEARNER'S CHARACTERISTICS IS SUGGESTED FOR DISCUSSION IN SOME FUTURE PROJECTS.

HAVING IN MIND SOME CHARACTERISTICS OF THE INTELLECTUAL REALIZATION OF THE LEARNER, THE DIFFICULT THEMES AND SO ON, EXPRESSED BY THE MATHEMATICAL EXPECTATIONS $\overline{XI}$ OF LEARNER'S MARKS ON N - 1 CHAPTERS, WHERE:

$\overline{\overline{XN}}$ - MATHEMATICAL EXPECTATION OF THE MARKS OF (K - 1) EDUCATED ON THE N-TH PART OF THE SUBJECT,

$\overline{\overline{X}}$ - MATHEMATICAL EXPECTATION OF THE MARKS OF (K - 1) EDUCATED ON ALL SECTIONS OF THE SUBJECT

AND CONDITIONS, EXPRESSING THEIR RELATIONS, THE A PRIORI MARK OF THE I-TH LEARNER ON THE N-TH SECTION HAS THE FOLLOWING MATHEMATICAL EXPRESSION

$$\widetilde{X}_{in} = \begin{cases} \dfrac{\overline{X}_i \, \overline{X}_n}{\overline{\overline{X}}}, & \text{when } \overline{X}_i \leq \overline{\overline{X}} \\ X_{max} - \dfrac{(X_{max} - \overline{X}_i)(X_{max} - \overline{X}_n)}{(X_{max} - \overline{\overline{X}})}, & \text{when } \overline{X}_i > \overline{\overline{X}} \end{cases}$$

WHERE X MAX = B.

C. MANAGEMENT OF EDUCATIONAL PROCESSES AT SCHOOL OR UNIVERSITY

IN THE GENERAL CASE, THE PLANNING AND MANAGEMENT OF A SCHOOL OR UNIVERSITY SHOULD NOT DIFFER FROM THE PLANNING AND MANAGEMENT OF AN INDUSTRIAL COMPANY. AS MENTIONED ABOVE, HERE WE MEAN THE REPRODUCTION OF INTELLECTUAL VALUES, SOCIAL EXPERIENCE AND KNOWLEDGE. BEARING IN MIND SOME SPECIFIC FEATURES, A PARALLEL EXAMINATION OF A SCHOOL AND UNIVERSITY IS CARRIED OUT HERE. AT SCHOOL THERE ARE FEWER PUPILS AND TEACHERS, FEWER SUBJECTS AND THEREFORE LESS ADMINISTRATIVE AND ECONOMIC ACTIVITY. ON THE OTHER HAND, THE NUMBER OF SCHOOLS IS LARGER AND EACH MISTAKE OF THE MANAGEMENT SYSTEM, OF PLANNING AND FORECASTING IS MULTIPLIED.

IN THE HIGHER SCHOOLS, IN ADDITION TO THE GREAT NUMBER OF STUDENTS, THERE IS A GREATER VARIETY OF SUBJECTS. IN ALMOST ALL HIGHER SCHOOLS RESEARCH AND PRODUCTION ACTIVITIES ARE DEVELOPED. THAT IS WHY A SYSTEM FOR PLANNING AND MANAGEMENT IS REQUIRED. AGAIN, APPLICATION OF COMPUTERS AND MANAGING SYSTEMS IS NECESSARY BECAUSE THERE IS A GREAT DEAL OF INFORMATION TO BE PROCESSED.

THE COMPUTERIZED INFORMATION AND MANAGING SYSTEMS INCLUDE INTERRELATED SUBSYSTEMS: THE NECESSARY EQUIPMENT AND SUPPLY, FINANCIAL AND ACCOUNTING ACTIVITIES, SALARIES INCLUDED, MANPOWER - PUPILS AND STUDENTS, TEACHING STAFF, ETC.

TYPICAL OF SUCH SYSTEMS IS THE ACCUMULATION AND PROCESSING OF INFORMATION ABOUT KNOWLEDGE ATTAINMENT BY EACH TRAINEE OR A GROUP OF TRAINED PEOPLE CONCERNING A DEFINITE SUBJECT OR ALL SUBJECTS. DATA ACCUMULATION IS EFFECTED BY MEANS OF INTERACTIVE VIDEOCOMPUTER SYSTEMS, ORAL EXAMINATIONS, ETC.

THE CORRECT PLANNING AND OPTIMAL MANAGEMENT OF THE EDUCATIONAL PROCESS IS IMPOSSIBLE WITHOUT THE EXAMINATION OF THE CORRELATIONS BETWEEN THE CONSOLIDATION OF DIFFERENT SUBJECTS, THE DYNAMICS OF KNOWLEDGE ASSIMILATION BY EACH TRAINEE IN COMPARISON TO THE GROUP TRAINED, THE ELEMENTS OF DIFFERENT SUBJECTS WHICH ARE DIFFICULT TO ASSIMILATE AND THE RELATIONS BETWEEN THEM, THE LEVEL OF KNOWLEDGE ACQUISITION OF THE SAME SUBJECTS FOR DIFFERENT LECTURERS, ETC.

INFORMATION ON DIFFERENT AUTOMATED SYSTEMS FOR CONTROL OVER THE TRAINING PROCESS CAN BE FOUND IN THE SPECIALIZED LITERATURE, BUT THOSE SYSTEMS ARE NOT YET WIDELY APPLIED. IN MOST CASES, A SCIENTIFIC EXPERIMENT IS CARRIED OUT BUT NO CONSEQUENT APPLICATION TAKES PLACE. WE BELIEVE THE REASON OF THAT IS THE GREAT NUMBER OF TABLES EMBARASSING LECTURERS AND MANAGERS WITH CUMBERSOME INFORMATION, BUT PERHAPS THE BIGGEST HINDRANCE IS INFORMATION PRESENTED INAPPROPRIATELY IN A FORM DIFFICULT TO ASSIMILATE.WE HAVE FOUND OUT THAT THE APPLICATION OF VOLUME VISUALIZATION METHODS TO SCIENTIFIC RESULTS WOULD DECREASE THE NECESSITY OF A GREAT QUANTITY OF PAPER. BUT IT WOULD NOT REDUCE IN ANY WAY THE INFORMATIVE VALUE OF MESSAGES. VOLUME VISUALIZATION WILL MAKE THESE MESSAGES EASY TO APPREHEND AND EFFECTIVE DECISIONS WOULD EASILY BE MADE. WE ALSO THINK THAT MAKING A DECISION, UNLIKE PRODUCTION, IS A VERY SIGNIFICANT AND RESPONSIBLE PROCESS BECAUSE IT CONCERNS THE INTELLECTUAL DEVELOPMENT OF YOUNG PEOPLE, THE FUTURE OF THE WORLD.

TAKING SUCH DECISIONS SHOULD BE BASED ON SCIENTIFIC RULES, PROCESSING OF DATA FOR THE DEVELOPMENT OF THE EDUCATIONAL PROCESS AND HUMAN EXPERIENCE.

IN MANY DEVELOPING COUNTRIES, WHERE THE ILLITERACY IS NOT YET ERADICATED, THE SCHOOL PLAYS A SIGNIFICANT ROLE IN EDUCATIONAL REFORMS. THEREFORE THE REALISTIC PRESENTATION OF RESULTS IS CRUCIAL TO EDUCATIONAL PLANNING AND MANAGEMENT NOT ONLY ON A NATIONAL, BUT ALSO ON A WORLD SCALE.

D. MANAGEMENT OF EDUCATIONAL PROCESSES IN THE MINISTRY

PLANNING AND MANAGEMENT OF EDUCATION AT THAT LEVEL REQUIRES PROCESSING OF A GREATER VOLUME OF INFORMATION, ACCUMULATED DATA FROM SCHOOLS OR HIGHER SCHOOLS. AT LOWER LEVELS OF EDUCATION INFORMATION PROCESSING AND ITS IMPLEMENTATION IS DIFFICULT WITHOUT COMPUTER VISUALIZATION AND VIDEOCOMPUTER SYSTEMS.

I WOULD LIKE TO CONCERN MYSELF WITH THE APPLICATION OF VIDEOCOMPUTER TECHNOLOGIES ONLY BECAUSE OF THE LIMITED VOLUME OF THIS REPORT AND BECAUSE THERE IS ANOTHER MATERIAL CONCERNING "PRESENT STATE AND FUTURE OF THE PLANNING AND MANAGEMENT OF HIGHER EDUCATION IN BULGARIA".

GENERALLY SPEAKING, PLANNING AND MANAGEMENT OF THE EDUCATIONAL PROCESS AT A NATIONAL LEVEL ARE BASED ON SCIENTIFIC MODELS WHICH CAN BE GRAPHICALLY REPRESENTED. ON THE OTHER HAND, THE INFORMATION ABOUT MODEL REALIZATION COULD BE PROCESSED IN SUCH A WAY AS TO RECEIVE A REAL VOLUME IMAGE OF DATA ACCUMULATED BY THE EDUCATIONAL PROGRAMME. THE CONTRAST BETWEEN TWO GRAPHIC IMAGES ENABLES A VISUAL AND ABSTRACT EVALUATION OF RESULTS ACHIEVED. ON THE OTHER HAND, MATHEMATICAL METHODS, IMAGE IDENTIFYING METHODS, ETC. QUANTITATIVELY ASSESS THE VALIDITY AND ADEQUATENESS OF RESULTS. THUS, THE PROCESS DEVELOPMENT CAN BE RECORDED BY VIDEO, OR IN SOME OTHER WAY. THE PICTURE TRACES THE DYNAMICS OF THE PROCESS AND ITS SPECIFIC CHARACTERISTICS. PROCESS CONTROL IS CARRIED OUT IN TWO WAYS:

- EDITING THE MODEL IMAGE BY PROCESSING THE PARAMETERS USED FOR ITS DESCRIPTION;

- EDITING THE DATA IMAGE THROUGH REAL OPTIMIZATION AND CONTROL OF THE PROCESS.

THE METHOD OFFERED HERE ALLOWS MORE EFFICIENT DATA STORAGE WITH A VIEW TO FUTURE PLANNING AND PREDICTION. IT ALSO REDUCES THE AMOUNT OF THE PAPER USED AND THE NEGATIVE ATTITUDE OF ADMINISTRATORS AND MANAGERS TO COMPUTERIZING THE EDUCATIONAL PROCESS.

3. EFFECTIVENESS OF THE EDUCATIONAL PROCESSES

EFFECTIVENESS OF EDUCATION (EFF) IS EXPRESSED AS A RATIO BETWEEN THE SUM TOTAL OF EFFECTIVENESS OF EDUCATION (EFF ED), OF TRAINING (EFF TR) AND OF ORGANIZATION AND MANAGEMENT OF THE EDUCATIONAL PROCESS (EFF ORG) AND THE EXPENSES FOR THEIR REALIZATION

$$\text{EFF} = \frac{\text{EFF ED} + \text{EFF TR} + \text{EFF ORG}}{\text{EXPENSES}}$$

THE APPROACH IS SUITABLE FOR COMPARISON BETWEEN TWO EDUCATIONAL STRATEGIES WHICH HAVE ATTAINED THE SAME OBJECTIVE OR HAVE THE SAME STARTING POINT. DETERMINATION OF THE DIFFERENT EFFECTS AND ESPECIALLY THEIR DIMENSIONS FOR A JOINT PROCESSING IS EXTREMELY DIFFICULT. A POSSIBLE SOLUTION OF THE PROBLEM IS EVALUATING EFFECTS SEPARATELY AT EACH HIERARCHICAL LEVEL OF EDUCATION. EDUCATION AND TRAINING ARE USUALLY IMPLEMENTED AT THE LOWEST LEVELS (SCHOOLS, HIGHER SCHOOLS AND UNIVERSITIES) AND THEIR EFFECTIVENESS SHOULD BE CONSIDERED FROM THE POINT OF VIEW OF SCHOOL OR INSTITUTE EDUCATION. THE ASSESSMENT OF THE EDUCATION CONTROL EFFECTIVENESS IS DETERMINED BY COMPARING THE OBTAINED RESULTS WITH THOSE PLANNED IN ADVANCE.

THE EFFECTIVENESS OF THE EDUCATIONAL PROCESS AT AN INSTITUTION (EFF EP) MIGHT BE EXPRESSED AS THE SUM TOTAL OF EFFECTS ACHIEVED IN EDUCATION AND TRAINING (EFF ET), I.E. PSYCHOLOGICAL EFFECT (EFF P), SOCIAL EFFECT (EFF S), AS WELL AS ECONOMIC EFFECT (EFF E), DIVIDED BY THE EXPENSES USED FOR THEM:

$$\text{EFF EP} = \frac{\text{EFF ET} + \text{EFF P} + \text{EFF S} + \text{EFF E}}{\text{EXPENSES}}$$

THE EFFECTS LISTED ABOVE ARE ASSESSED IF THE RESULTS OBTAINED ARE IDENTICAL OR EXCEED THE EXPECTATION.

THE BASIS FOR AN EFFECTIVE RESEARCH SHOULD BE AN UNIVERSAL FORMALIZED DESCRIPTION OF THE TRAINING PROCESS REFLECTING ITS MAIN FEATURES. SOME PROBLEMS COULD ARISE HERE:

- MANY OF THE OBTAINED RESULTS COULD NOT BE QUANTITATIVELY MEASURED - THEY HAVE QUALITATIVE CHARACTERISTICS DIFFICULT TO FORMALIZE;

- CHARACTERISTICS CANNOT BE COMBINED IN UNIVERSAL, QUANTITATIVE MODELS, EVEN WHEN QUANTITATIVELY MEASURED, BECAUSE THEY ARE NO ADEQUATE EVALUATING METHODS;

- THE EXPENSES ARE DYNAMIC STRUCTURES BECAUSE OF THE VARIETY OF THE TECHNOLOGICAL AND ORGANIZATIONAL SOLUTIONS AND THE CONSTANTLY CHANGING PRICES.

DESPITE ALL THAT, UNIFIED MULTICRITERION EVALUATING MODELS ARE OBLIGATORY SINCE VALID CONCLUSIONS COULD BE REACHED ONLY BY USING A UNIFIED EVALUATING SYSTEM.

4. CONCLUSION

FINALLY I WOULD LIKE TO APOLOGISE FOR THE BRIEF PRESENTATION OF SO MANY AND SO SERIOUS PROPOSALS, WHICH REFLECTS UNFAVOURABLY ON THE STYLE AND CORRECTNESS OF THE EXPOSITION. I BELIEVE THE METHODS PROPOSED HERE ARE THE OBJECT OF INVESTIGATION OF A NUMBER OF OTHER SCIENTIFIC INSTITUTES, SOME OF WHICH ARE MENTIONED ABOVE. ONLY INTEGRATION OF THEIR EFFORTS UNDER THE AEGIS OF UNESCO WOULD HELP THE BUILDING UP OF A HARMONIOUS INTERNATIONAL SYSTEM FOR ORGANIZATION AND MANAGEMENT OF EDUCATION.

ONE OF THE POSSIBILITIES FOR THE IMPLEMENTATION OF THE SYSTEM IS THE SIGNING OF SOME PARALLEL RESEARCH CONTRACTS WITH DEVELOPED AND DEVELOPING COUNTRIES FROM ASIA, AFRICA, LATIN AMERICA, EAST AND WEST EUROPE WHICH ARE EXPECTED TO CONCLUDE WITH IMPLEMENTATION AND INTRODUCTION OF THE SYSTEM.

5. LITERATURE

JELEV, G. VIDEOCOMPUTER SYSTEMS IN EDUCATION. S.,TECHNIKA,1988

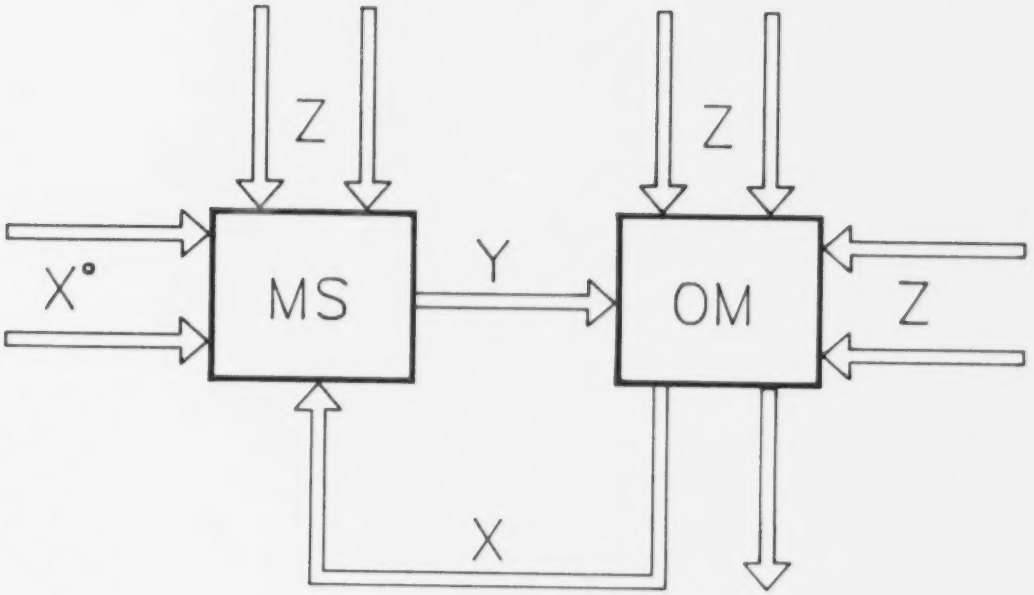


Fig.1

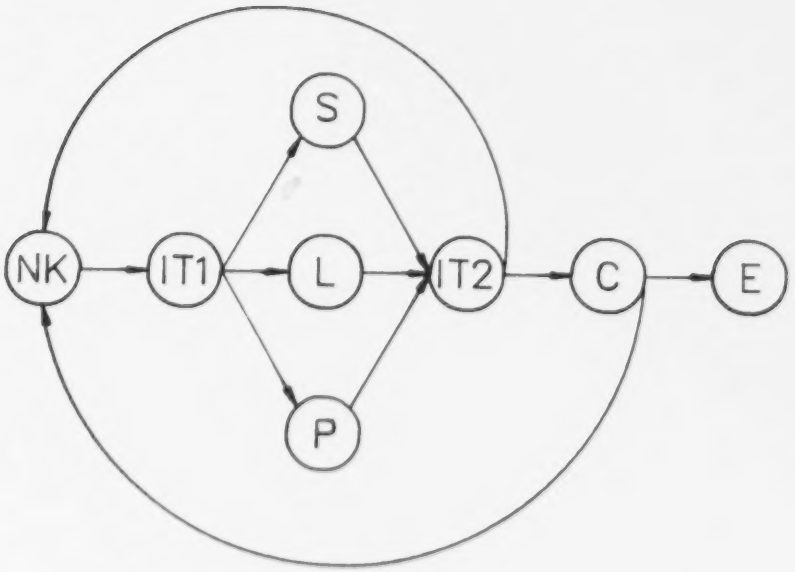
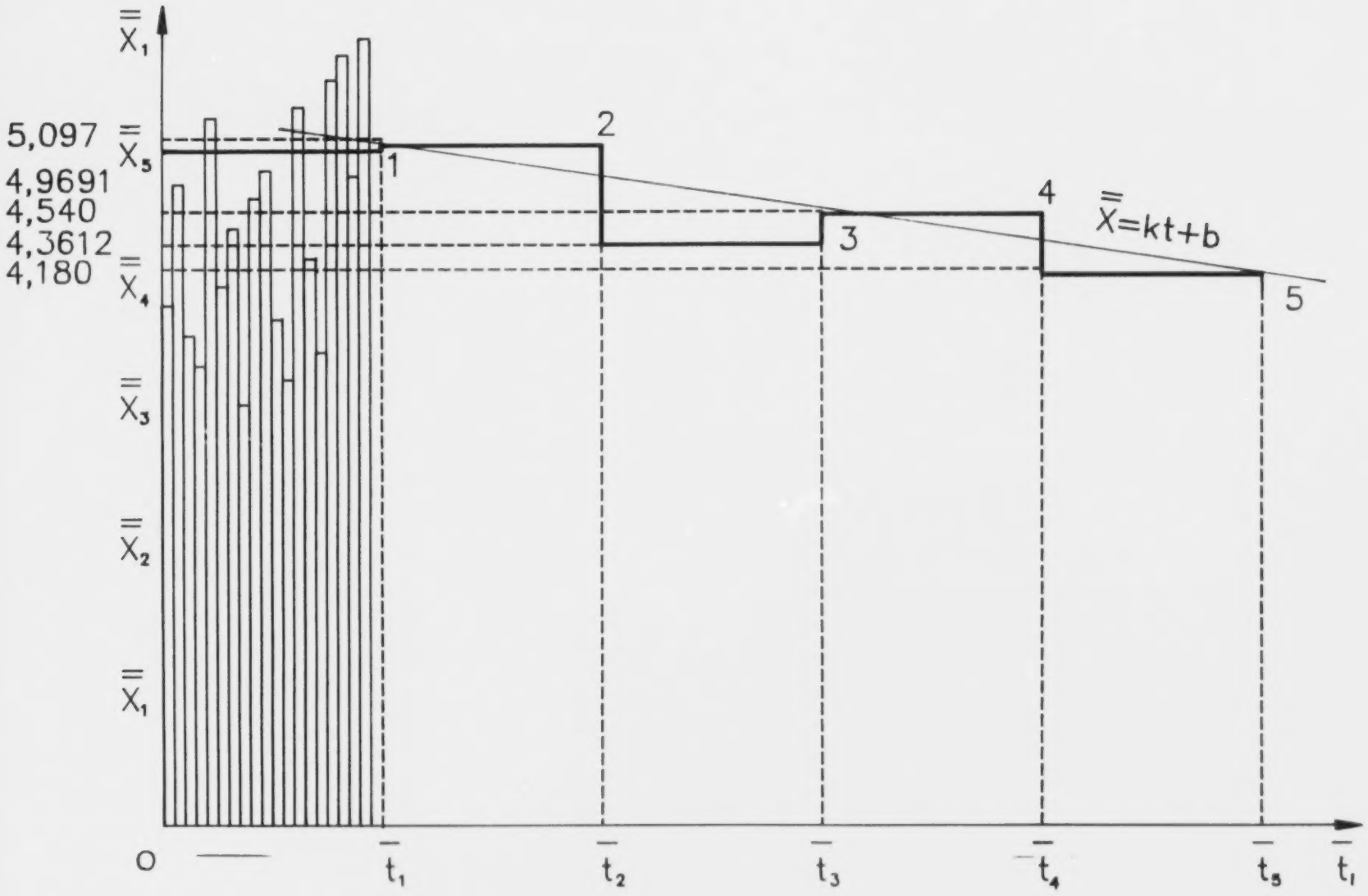


Fig.2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4,540
4,3612
4,180 $\bar{\bar{X}}_4$
$\bar{\bar{X}}_3$
$\bar{\bar{X}}_2$
$\bar{\bar{X}}_1$
1
2
3
4
5
$\bar{\bar{X}}=kt+b$
O
$\bar{t}_1$
$\bar{t}_2$
$\bar{t}_3$
$\bar{t}_4$
$\bar{t}_5$
$\bar{t}_i$

Fig.3